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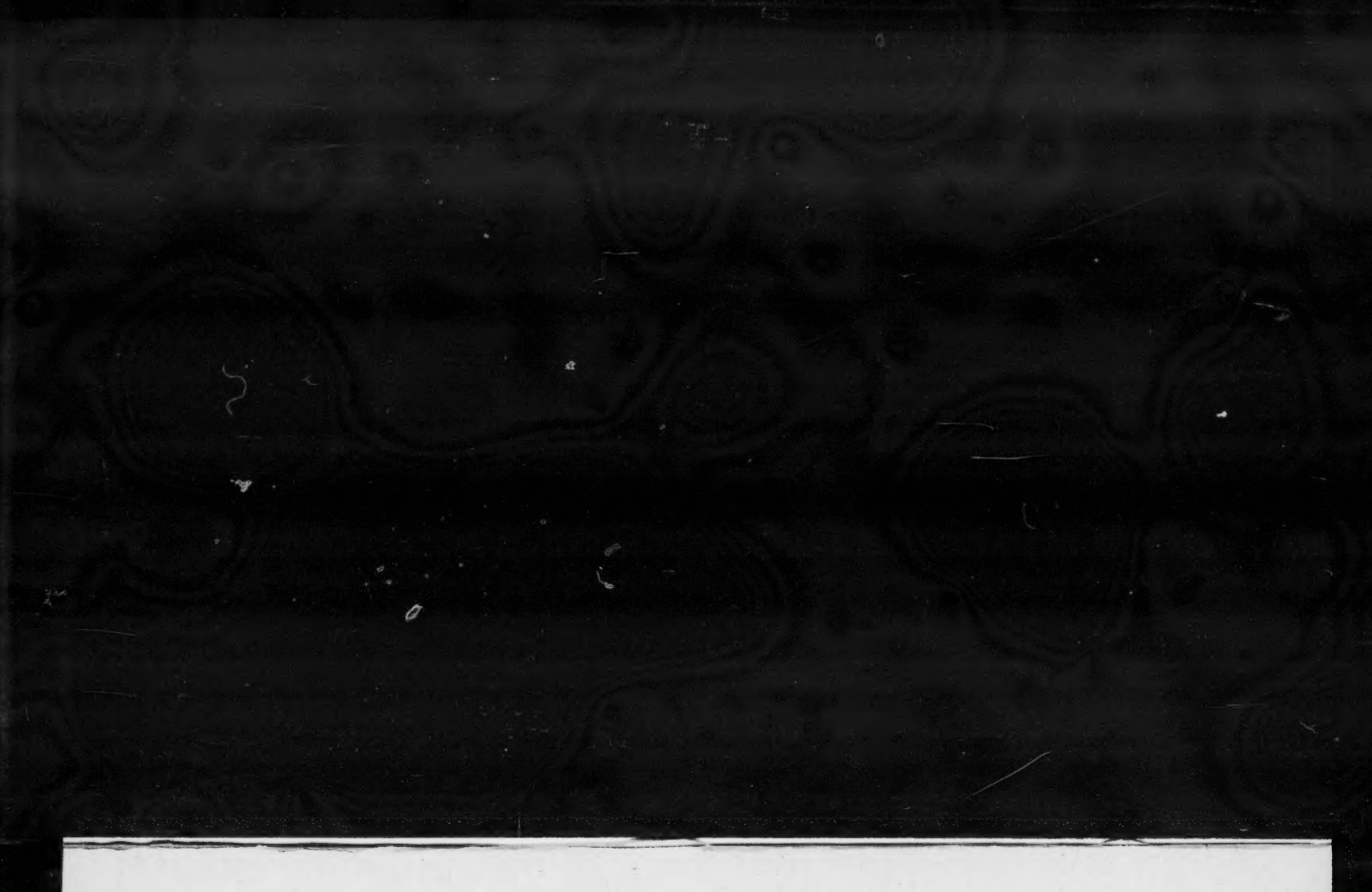

VOL. XV. NO. 1.— BOTANICAL GAZETTE.— JAN., 1890.

On the affinities of the Filicineæ.

DOUGLAS H. CAMPBELL.

No department of botany is more fascinating than the study of the phylogeny of the different groups of plants and their mutual relationships. The pteridophytes have naturally attracted special attention from their acknowledged affinity on the one hand to the bryophytes, and on the other to the flowering plants; but notwithstanding the numerous investigations upon them, there is still much difference of opinion respecting affinities among themselves and to the neighboring groups.

The present paper was prompted by a recent very suggestive and interesting article by Bower,[1] in which he maintains, with a good show of reason, the hypothesis most generally accepted at present as to the origin and affinities of the Filicineæ, viz.: the primitive character of the Hymenophyllaceæ and the derivative nature of the other Filicineæ. He shows by a careful comparative study of the meristems of the different members of the sporophyte that there is a regular increase in complexity from the Hymenophyllaceæ to the Marattiaceæ, and as he thinks to the Ophioglosseæ, though admitting certain difficulties in the latter case.

Having devoted much time to the study of these problems myself, and having reached somewhat different conclusions, this paper is presented to call attention to certain phases of the above view which it is believed are not warranted by facts.

According to this view the leptosporangiate ferns are regarded as the most primitive of the Filicineæ, and, of these, the Hymenophyllaceæ, undoubtedly the simplest in structure, also the most primitive, and probably derived from some form intermediate in character between existing bryophytes and the higher green algæ. These conclusions are based upon the very simple protonema-like prothallium of some species of Hymenophyllum, which it is assumed resembles the ancestral form from which bryophytes and pteridophytes both sprung. Grave difficulties, however, arise as

[1] The comparative examination of the meristems of ferns, as a phylogenetic study. Ann. of Bot. iii, no. 11.

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soon as we attempt to homologize the sporophyte of any leptosporangiate fern with that of any known alga or bryophyte. Anything in the least resembling the epidermal sporangia of the Filices is absolutely unknown outside of the group, and the high degree of development of the body of even the simplest of these is separated by an immense distance from the sporangium of any known form among either bryophytes or algæ. It must be borne in mind that the prothallium of a Hymenophyllum corresponds not merely to the protonema of a moss, but to the protonema *plus* the leafy sexual plant.

If we go back to the older botanists we find a different view as to the origin of the pteridophytes, though here also the leptosporangiate ferns seem to be regarded as the more primitive forms. According to this earlier view the pteridophytes probably originated from some simple form allied to the Hepaticæ. The evident resemblance between such a form as Anthoceros, for example, and an ordinary fern-prothallium is obvious, and I hope to show that there is some good reason for reconsidering, at least, this older view.

Leitgeb[2] calls attention to the well-known but significant fact that among the Anthoceroteæ alone, of all known bryophytes, the growth of the sporogonium is unlimited, continuing to grow at the base as long as the plant lives. The sporogonium is relatively very large and contains abundant green parenchyma with large intercellular spaces communicating with stomata of the same structure as those of the higher vascular plants, so that so far as assimilation is concerned, it is quite independent of the oöphyte. Add to this that the columella, both in structure and position, closely resembles the young axial fibro-vascular bundles of the embryos of pteridophytes, and we see how closely the sporogonium of Anthoceros approaches to what might be called an independent vascular plant. If we could imagine such a sporogonium to develop a root fastening it in the ground, and thus rendering it entirely independent of the oöphyte, we should have the simplest possible form of a pteridophyte.

In Anthoceros, however (and the same is true throughout the bryophytes), the spores are of strictly endogenous origin, *i. e.*, the plant is eusporangiate, and this, as I shall endeavor to show, is probably the primitive condition among the Filicineæ.

Because the higher pteridophytes and spermaphytes are eusporangiate is no reason why this should not be the primi-

[2]Untersuchungen über die Lebermoose.

tive condition. It would be as reasonable to argue that, because in man the hand is pentadactyl, while in the horse it is monodactyl, that the latter approaches in this respect more nearly the primitive mammalian type than does the former, being admittedly an animal of lower rank than man.

The Leptosporangiatæ may therefore be looked upon as bearing much the same sort of relation to the eusporangiate pteridophytes and spermaphytes as some such peculiarly specialized group as the ungulates bears to the other mammalia.

If we examine the different groups of the pteridophytes, where shall we find the form that corresponds most nearly to this assumed primitive type? I think the answer is Ophioglossum. In such a form as O. vulgatum the sporophyte is reduced to almost its simplest expression, little more than a single two-lobed leaf and a few roots of the simplest form, the stem being reduced to a minimum. The sporangia are mere cavities in the tissue of the fertile leaf-segment, scarcely indicated on the surface and covered over with an undifferentiated stoma-bearing epidermis. If we compare this with the sporogonium of Anthoceros we shall find in the latter that the greatest difference, aside from the absence of true fibro-vascular bundles, is that the sporogenous tissue forms a continuous layer surrounding the columella. The epidermis develops stomata of precisely the same character as those of Ophioglossum and other vascular plants. Separate the sporogenous tissue in distinct sporangia, each with its own external opening, and develop a few vessels in the columella, and we have a structure approaching very near to what really attains in the fertile segment of the leaf of Ophioglossum.

The tissues of the Ophioglossaceæ are remarkably simple in structure, this being most noticeable in Ophioglossum.[3] In the latter the predominating tissue is an undifferentiated spongy parenchyma.[4] No special hypoderma is recognizable, the absence of the abundant sclerenchyma of most pteridophytes being very noticeable, as well as the small size and simple structure of the fibro-vascular bundles. The stem and root grow from a single apical cell, indicating thus, according to Bower's view,[5] a primitive condition as compared with the higher pteridophytes and spermaphytes.

Unfortunately our knowledge of the prothallium and em-

[3] Gœbel, "Outlines," p. 250; De Bary, "Comparative Anatomy," etc.

[4] Op. cit.

[5] L. c. p. 318, 366.

bryo is so scanty as to make it impossible to draw positive conclusions from a comparison with Anthoceros. It is, however, highly probable that the prothallium is more like that of the Marattiaceæ than any of the other pteridophytes, as the sporophytes of the two agree in many particulars, and this harmonizes with our very imperfect knowledge of the prothallium derived from the works of Hofmeister[6] and Mettenius.[7] The prothallia of the Marattiaceæ[8] show most surprising analogies with the liverworts, and, in some noticeable particulars, with Anthoceros. The archegonia are deeply sunk in the oöphyte, as in Anthoceros, and, according to Jenkman,[9] possess three canal cells, in which respect, so far as at present known, they stand alone among the ferns, but approach the bryophytes. The antheridium, also sunk in the prothallium, recalls, though distinctly, the endogenous antheridium of Anthoceroteæ, the only ones of all known bryophytes in which this is the case.

The statements of Hofmeister[10] and Mettenius,[11] that the prothallia of the Ophioglosseæ are destitute of chlorophyll, require confirmation; and it is highly probable, as Gœbel suggests,[12] that the earlier stages, at least, are provided with chlorophyll. Until quite recently the same statement was universally accepted for Lycopodium, but the researches of Treub[13] and Gœbel[14] have shown that this is not the case, but that the prothallia of Lycopodium are abundantly provided with chlorophyll.

What relation, then, do the Ophioglosseæ bear to the other Filicineæ? As Bower has shown,[15] there is a complete series of homosporous Filicineæ, with the Hymenophyllaceæ at one end and the Marattiaceæ, and perhaps the Ophioglosseæ, at the other; and this arrangement probably is the correct one.

Within the Ophioglosseæ the different species of Botrychium show a very beautiful series of forms connecting Ophioglossum with the Leptosporangiatæ. In the form of the sporangia, as well as in their position, Osmunda comes

6 Hofmeister, "Higher Cryptogamia," p. 307.
7 Gœbel's "Outlines," p. 245–46.
8 Jenkman, "Generation sexuél des Marattiacées."
9 Op. c. figs. 102, 103.
10 Loc. cit.
11 Loc. cit.
12 Loc. cit. p. 215.
13 Annals of the Bot. Garden of Buitenzorg.
14 Bot. Zeitung, 1887.
15 Loc. cit.

nearer to Botrychium than do the Marattiaceæ, although in some other respects this is not the case. While the fibro-vascular bundles of Ophioglossum are collateral[16] (which is also true of Osmunda[17]) those of Botrychium are concentric, this being particularly noticeable in the larger species, such as B. ternatum and B. Virginianum. In these larger species, too, there is some slight trace of a hypoderma distinct from the rest of the ground tissue, and the bundle-sheath is pretty well defined.

As has been shown, too, while in B. simplex the leaf is folded straight in the bud, in B. Virginianum it is bent over, thus approaching the circinate vernation of the Marattiaceæ and Filices.

If we assume Ophioglossum to be the higher form (being most strongly eusporangiate), it is certainly difficult to account for the gradual simplification of the tissues as we pass from the Filices through Botrychium or the Marattiaceæ. Such a simplification can not be accounted for from the habits of the plant, as it is neither an aquatic nor a parasite.

The greatest difficulty, however, it seems to me, in regarding the Hymenophyllaceæ as primitive forms as compared with the Marattiaceæ and Ophioglosseæ is the increase in the size of the prothallium as we go from the former to the latter. Bower[18] tries to explain this by assuming that the size and complexity of the prothallium are correlated with the increasing complexity of the sporophyte, and like it due to the change from a semi-aquatic to a purely terrestrial habit.

There are two objections to this view: First, if we admit that the cycads are related to the Marattiaceæ (which Bower seems to think very probable), we must suppose a reduction of the prothallium again to produce the heterosporous forms that must have intervened. That there should be an *increase* in the size of the prothallium up to a certain point, keeping pace with the development of the sporophyte, and then a retrogression, is difficult to understand, and is certainly improbable. If on the other hand we admit that the Marattiaceæ are primitive forms, allied, perhaps, to Ophioglossum, the massive character of the oöphyte is easily comprehensible, and the possible derivation of the cycads from them could then be understood by assuming a series ending in some heterosporous form leading up to the former.[19]

[16] De Bary, op. c. pp. 321, 364.

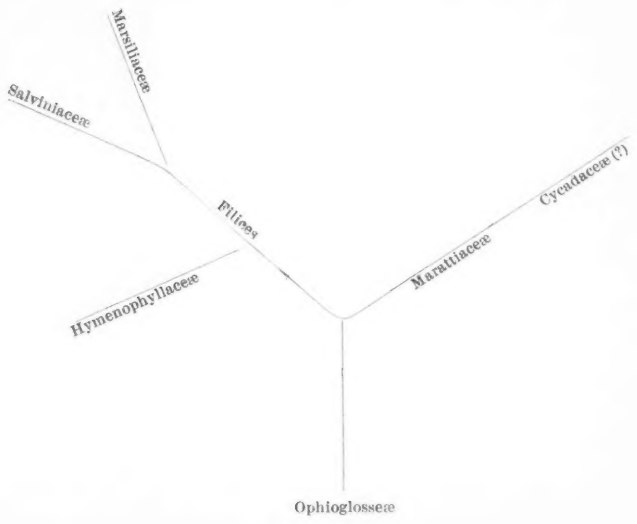
[17] De Bary, l. c.

[18] Op. cit., p. 370.

[19] Bower suggests that possibly Isoetes may be such a form, and this seems to be also the view of Vines.

The second difficulty mentioned is the fact that just those forms, viz., Ophioglossum and Equisetum, which are the most essentially eusporangiate of all pteridophytes, are characterized by the root and stem growing by a regular apical cell, a point that Bower regards as evidence of primitive structure.

The accompanying diagram will show the relationship assumed here:



It will be seen that there are two main branches, one through the Marattiaceæ, possibly terminating in the Cycadeæ; the other the Filices, giving rise to two branches ending in the two heterosporous groups, the Marsiliaceæ and the Salviniaceæ. The Hymenophyllaceæ, according to this view, must be looked upon as a degenerate group, the simple prothallium and sporophyte resulting from the semi-aquatic habit of the plants.

Just at what point the Leptosporangiatæ branched off, assuming the view here taken to be correct, it will be impossible to decide until the oöphyte of the different forms is better known than at present. The same difficulty is true

with regard to the origin of the Salviniaceæ, which are certainly not closely related to the Marsiliaceæ.[20]

With our very imperfect knowledge of the oöphyte of the Ophioglosseæ, it would be rash to assume that the group originated from the Anthoceroteæ; indeed there are very strong objections to be brought against such a view. In spite of the resemblance of the sexual organs of the Anthoceroteæ to those of the Marattiaceæ, they are nevertheless in their development much more like those of the other liverworts. Again, the Anthoceroteæ are peculiar in the single large chloroplast in each cell; recalling strongly, in this particular, such algæ as Coleochæte, where this is also the case, and suggesting a possible derivation from similar forms.

Nevertheless, since in Anthoceros there are such striking resemblances to the oöphyte of the Marattiaceæ, and the sporogonium becomes so nearly independent, we can readily conceive of some allied form with chloroplasts of the ordinary type, and with sexual organs approximating still more closely those of the pteridophytes, in which by the development of a root the sporogonium would become entirely independent. It would be but a step from such a form to the simpler Ophioglosseæ.

Bower[21] admits that some such view as the one advanced here is capable of defense, but does not believe it to be the true one. He does not, however, nor does any other botanist[22] so far as I know, give any satisfactory explanation of the origin of the sporophyte of Hymenophyllum from any known or even hypothetical ancestral form.

From the foregoing pages it is evident that there is something, at least, to be said in favor of assuming that Ophioglossum and the other eusporangiate ferns are primitive rather than derivative forms, but until the life-history of these forms, as well as of many of the Leptosporangiatæ is thoroughly known it will be unsafe to be too positive as to their systematic positions.

Bloomington, Ind.

[The author is anxious to procure material for the study of the development of the Ophioglosseæ and will be much indebted to any of the readers of the GAZETTE who can supply fresh fruiting specimens, especially of Ophioglossum. It is particularly desired to have fresh spores of as many species of the latter as possible.]

[20] See Campbell, "The systematic position of the Rhizocarpeæ," Bull. Torrey Bot. Club, October, 1888. Also, "Development of Pilularia globulifera," Ann. of Bot. vol. ii. no. 7.

[21] Op. cit. p. 374.

[22] I have not had an opportunity of examining Gœbel's investigations on Hymenophyllaceæ in the Annals of the Botanical Garden of Buitenzorg.

The lily disease in Bermuda.

ALEXANDER LIVINGSTON KEAN.

(WITH PLATE I.)

In the winter of 1888, through the kindness of General Russell Hastings, of Hamilton, Bermuda, I had the opportunity of investigating a disease, epidemic in the lily fields there from March to July. Diseased specimens had previously been shown to several naturalists who had visited Bermuda, and a few of the same had been sent to the United States for examination. None of those who saw these specimens were able, upon a merely cursory examination, to identify the disease; so that the subject still remained open for investigation.

Towards the end of February I sailed for Bermuda, in order to observe personally the phenomena attendant upon the first stages of the disease, which usually begins early in March. A few words on the cultivation of the lily in Bermuda and upon the history of the disease may not be out of place.

The industry is a comparatively new but prosperous one, being only a few years old. The lily cultivated is the so-called Lilium Harrisii, a dwarf variety of Lilium longiflorum. This variety has been propagated from year to year by bulb-scales and by a few plants raised yearly from seed. The latter are always more vigorous than those raised from bulb scales; they tend, however, to return to the original longiflorum type. The bulbs, planted in the early autumn, grow throughout the winter months and flower in the spring. They are taken up again early in the summer, and shipped to the United States, where a good market is also found for the flowers in the spring months. The lilies are planted in rows, in small fields; these fields are surrounded by high oleander hedges, which serve to protect the plants from the wind.

So far as I know, the lily disease was first noticed about 1885, since which time it has yearly become more serious, until at present it threatens to do serious damage to the lily crop. It makes its appearance in the spring when the days begin to grow warm. This marked difference in the temperature between day and night results in a heavy fall of dew, so that even after the sun is high in the heavens

large dew drops may be found upon the lily leaves. A little cool weather, or a few warm, dry days free from dew, will check the activity of the disease, while a warm, damp day will cause it to spread with great rapidity. The disease first appears as a minute orange-colored spot upon a leaf or flower, usually on the upper side of the leaf. Fig. 1 (*a*) shows an early stage. The spot gradually increases in size, and finally spreads throughout the whole leaf. In this way whole plants may be killed, and only the stalks left standing. It is not unusual to find several of these spots on the same leaf, as in fig. 1. If, for any reason, the progress of the disease is checked, these become dry, leathery patches of a buff color.

It was thought possible, by some of those who had seen the diseased specimens, that the spots might be due to the stings of insects. Though at first this did not seem unlikely, a closer acquaintance with the disease rendered it highly improbable.

Sections of the spots examined under the microscope revealed nothing more than that in the diseased area the structure of the leaf had collapsed; while along the edges of the spot the cells were somewhat swollen and the cell walls thickened. The cell contents were slightly shrunken, and contained a number of bright dots which did not stain with the ordinary reagents. In a few cases where specimens were teased an occasional hypha of a fungus was found, which, however, might easily have come from external contamination. In a slightly more advanced stage of the disease hyphæ of a fungus might be found ramifying through the soft decaying tissues, the gonidiophores appearing on the surface (fig. 2).

This fungus invariably appears in advanced stages of the disease; moreover, it is always the first to appear. Other fungi, such as Macrosporium, Eurotium, and Penicillium, also appear on the decaying leaves, but this fungus invariably precedes all others. At the same time, as it could never be found until the tissue had become pretty thoroughly rotten, it seemed at first sight to be rather a consequence than a cause of the disease.

Early in April I was obliged to return to the United States, and for a time my investigations were interrupted to be resumed again in the summer, when I had specimens forwarded to me from Bermuda. It had seemed possible that the disease might be due to bacteria, on account of its pecul-

iarly rapid growth and its susceptibility to climatic conditions, as well as for other reasons. Accordingly a series of cultures in nutrient gelatine and agar-agar was begun. By this method two distinct species of bacteria were isolated from the spots, either of which might have been the cause of the disease.

Inoculations were attempted, both in the laboratory and in the garden, all of which failed to produce the disease, but as the American climate is dry, and therefore unfavorable, it was thought that the bacteria had not been given a sufficient trial, and so it was decided to let the whole matter lie over until the next winter, when inoculation experiments could be made in Bermuda.

Shortly before visiting Bermuda for the second time my attention was again directed to the fungus as a cause of the disease by the appearance of Professor Marshall Ward's description of a similar disease caused by a fungus growing upon the Lilium candidum in England. Upon my arrival in Bermuda, in February, 1889, I renewed my efforts at inoculation with bacteria, but in every case without success. I also placed a number of plants in glass jars which contained fluid cultures, to see if by any chance the action of bacteria upon the bulb might not have something to do with the epidemic. These plants, however, remained remarkably healthy, as did also a number of plants from which I removed the bulbs, placing the stalks in fluid cultures, so that the bacteria had direct access to the tissues of the plants. The weather was extremely unfavorable, so that although I saw numerous small spots, I met with none large enough to show gonidiophores of the fungus. I was, therefore, unable to complete my experiments satisfactorily in Bermuda, as I could not even get a culture of the fungus as a starting point. Since my return, however, I have had specimens sent to me and have been able to carry on a series of experiments in the laboratory, by means of which I have, at length, ascertained definitely the cause of the disease. Meanwhile I have repeatedly tried to inoculate plants in the laboratory with bacteria, all of which attempts have been signal failures, as have been likewise all attempts to produce the disease by fungus spores sown in a drop of Irish moss which had been placed upon a leaf. In the latter case it was found impossible (without resort to artificial means) to keep the air of the room moist enough so that the drop of Irish moss would not dry up soon after it was put upon the leaf. I readily succeeded, how-

ever, in getting numerous Irish moss cultures of the fungus, and I have also grown it in water both ordinary and sterilized, and in hanging drops as well as in drops merely placed upon a slide.

In my next experiments leaves, freshly picked from the plant, were used and kept fresh in a beaker of water, which was placed under a bell glass, where there was a second beaker of steaming water, which was occasionally renewed so that the atmosphere was kept warm and moist, thus making the conditions highly favorable. Bacteriological experiments under these conditions failed as in all previous experiments. On the other hand, experiments with the fungus were entirely successful. If a drop of Irish moss, placed on the surface of a leaf is inoculated with spores of the fungus mentioned above, a disease spot will appear in about two days, unless in some way the drop has dried up, or been otherwise disturbed. If the drop has simply dried up, it is only necessary to moisten it again, and the spot will soon appear. About the third or fourth day the gonidiophores appear, and soon bear compact bunches of gonidia, the whole forming a downy growth on both sides of the leaf. It makes no difference whether the original spores are sown in a drop on the upper or the under side of the leaf. In either case the disease is produced. I have substituted drops of water for the Irish moss as a culture medium with equal success, and to exclude contamination, drops of sterilized water were used with which I also obtained excellent results.

To prove beyond all doubt that the fungus is the cause of the disease, the following experiment was made: Into a tube of sterilized nutrient gelatine some fungus spores were introduced on the tip of a sterilized needle. The contents of the tube were then "plated" according to Koch's method. The fungus grows luxuriantly in this medium, and can thus be obtained free from bacteria or other fungi. Spores are less quickly produced on the rich gelatine than on the comparatively poor Irish moss. Inoculations made with spores from a pure culture of this kind readily produced the characteristic spots, while blank control experiments showed nothing whatever.

The fungus appeared to me to be identical with the Botrytis recently described by Prof. Marshall Ward[1] as growing upon the Lilium candidum in England, and from a specimen sent to him Professor Ward has identified it as the same.

[1] A Lily Disease, by H. Marshall Ward, M. A., F. R. S., F. L. S. Annals of Botany, vol. ii. no. 7, Nov., 1888.

So far as I know the Lilium candidum is exempt from the disease in Bermuda, but this species is only occasionally grown there, and then with only a few together. Under similar circumstances the longiflorum also is generally exempt, the plants in the fields alone suffering. The true longiflorum is not considered to be as susceptible to the disease as the Harrisii. Since Marshall Ward has described the Botrytis and its method of growth in so complete a manner, it would be superfluous for me to enter upon a detailed description of it. I shall, therefore, give but a brief summary of the main facts in its life history, as I have observed them.

The gonidia are ovoid in shape, about 0.02 mm. long and about 0.015 mm. broad. They are, at first, colorless, but when mature are light brown, the whole gonidiophore passing through the same change of color. The gonidia are attached to the gonidiophores by means of slender sterigmata. These sterigmata are frequently found still adhering to the spore after it is entirely separated from the gonidiophore upon which it grew. While the normal shape of the spore is ovoid, spores are often found of different shapes, as those depicted in fig. 7. These forms, however, seem to belong to the period of germination, being simply conditions which the gonidia assume in the process of swelling. The spores are almost always ovoid, although in some old bunches they may sometimes be elongated and even divided by a partition. In germination the gonidium swells, the protoplasm becoming quite dense. Soon after, the wall begins to bulge out in several places, from which hyphæ are eventually protruded. One of these is generally more vigorous than the others, and grows much more rapidly, producing a complicated mycelium, while the other hyphæ are scarcely more than buds. The protoplasm of the rapidly growing tips of the hyphæ is quite dense, while that in the older hyphæ is clear and much vacuolated. Two remarkable features of the mycelium described by Marshall Ward I have, also, observed. These are, first, organs of attachment, consisting of thick cone-shaped tufts (fig. 5), developed upon the hyphæ when they come in contact with any foreign body which they are not able to penetrate. The second peculiarity is the development of cross branches between contiguous hyphæ, thus forming a network in the mycelium (fig. 6). The gonidiophores are, on the leaves, as a rule, about one mm. in height. When they reach this height, their tips begin to swell, and numerous small peg-like processes appear upon the heads

thus formed. These are the sterigmata, and on each of these a gonidium is formed (fig. 3). There are seldom fewer than four gonidia in a head, and they usually bear a much larger number. With perhaps thirty of these heads to the sq. mm., which is about the average number on an ordinary diseased leaf, it is not strange that, under favorable conditions, the disease should spread from leaf to leaf and from plant to plant, with surprising rapidity. If the growth of the fungus is unchecked, the erect hyphæ may bud out just below the gonidiophores, and after growing a short distance produce another bunch of gonidia, and so on, thus forming a series such as is shown in fig. 4.

In this disease the fungus does not grow in the sound tissues of the host, extracting nourishment from them, but the spores, germinating upon the surface of the leaf, in some way macerate it. According to Marshall Ward, this is done by means of a ferment secreted by the tips of the hyphæ. I have not as yet been able to experiment upon this ferment, but I have seen nothing to invalidate his view. The cell walls having been softened, the hyphæ pass through them, ramifying amongst the decaying tissues of the leaf.

The principal conclusions arrived at in this paper are the following:

1. A disease, hitherto unexplained, and threatening to become a serious epidemic in the lily fields of Bermuda, has been assigned to a definite cause.
2. There is no evidence that the blight is due to the stings of insects.
3. There is no evidence that the disease is caused by bacteria.
4. There is strong evidence that the disease is caused by a fungus, growing upon and within the leaves or flowers.
5. The fungus which causes the Bermuda lily disease is identical with the Botrytis recently described as the cause of a similar disease in England.

In making the investigation just described it was hoped not only to discover the cause of the disease, but also to suggest remedial measures. In this connection I may remark that the fungus itself seems to be delicate, so that its growth might probably be checked by almost any of the poisons used in the treatment of plant diseases, were it not for the difficulty of applying these effectively. Either a powder sprink-

led on the leaves, or a liquid sprayed upon them would here be ineffective, for the moisture would soon remove them, leaving the fungus free to grow. If, however, the fungus were present at the time of the application of the remedy, that part of it growing outside of the leaf might be killed, although that would not prevent the mycelium within the leaf from continuing to grow.

I have, however, observed that plants growing under the shelter of the oleander hedges are remarkably exempt from the disease. This I attributed at first to the drippings from the leaves, which I thought might partake of the acrid character of the sap of the oleander. I am inclined to believe, however, that it is rather because the lilies under the hedges are remarkably free from moisture. In fact, the overhanging hedge collects most of the dew, so that the dew drops do not readily gather upon the leaves of the lily plants, and thus, perhaps, no opportunity is given for the growth of the fungus.

It might, therefore, be found feasible to grow, in alternate rows with the lilies, some other crop, which, being higher and having more spreading foliage, should keep off the dew. A row of stakes with branches wattled among them might serve the same purpose and check the virulence, even if it did not entirely prevent the recurrence of the disease.

EXPLANATION OF PLATE I.—Fig. 1, Upper side of a leaf, with two spots upon it, showing different stages of the disease; (*a*) an early, and (*b*) a more advanced stage. Fig. 2, A section through a diseased spot when the disease is far advanced. The hyphæ occupy all the tissue in the diseased area. Fig. 3, A gonidiophore with its gonidia, showing the sterigmata and the attachment of the gonidia. Fig. 4, A series of bunches of gonidia on an old gonidiophore. Fig. 5, An organ of attachment. (After Marshall Ward.) Fig. 6, Part of a mycelium showing cross branches. Fig. 7, Gonidia; (*a*) an ordinary gonidium; (*b*) and (*c*) forms frequently assumed by gonidia shortly before germination. Fig. 8, A sprouting gonidium.

Biological Laboratory, Mass. Institute of Technology.

A new genus of Umbelliferæ.

JOHN M. COULTER AND J. N. ROSE.

(WITH PLATE II.)

From the interesting collections made in Guatemala under the direction of Mr. John Donnell Smith an Umbellifer was sent to us for determination, which proves to be the type of a new genus. We take pleasure in dedicating it to Mr. Smith, whose name should be prominently connected with the Guatemalan flora.

DONNELLSMITHIA. — Calyx-teeth obsolete. Fruit roundish-ovate, glabrous, strongly flattened laterally. Carpel flattened laterally, with equal filiform ribs, the intermediates distant from the laterals, and a thin pericarp with no strengthening cells (or the merest trace). Stylopodium wanting. Oil-tubes numerous, rather large, almost contiguous about the carpel, those of the commissural face more crowded and often larger. Seed invested by an oil-secreting layer which may develop small tubes, especially in the commissural region, the face with a deep and narrow sulcus. —Slender glabrous perennial, from rather slender elongated roots, with ternately compound leaves, narrow mostly entire leaflets, with involucre mostly present and no involucels, and yellow flowers in widely spreading loose umbels which are long-peduncled or sessile.

D. Guatemalensis. Glaucous: stem erect, simple or branched, 8 to 30 in. high: leaves mostly near the base, long-petioled, twice or thrice ternate, with lanceolate to oblong leaflets (1½ to 2 in. long, 3 to 6 lines broad), mostly entire and with revolute callous margin: umbels on long divergent slender peduncles or the latter often sessile, 5 or 6-rayed, with involucre mostly present and of 3 or 4 trifid bracts; rays 1 to 2 in. long; pedicels 2 to 3 lines long: fruit round-ovate, 1 to 1½ lines long.

Santa Rosa, Dept. Baja Verapaz, Guatemala, 5,000 feet altitude, July, 1887 (no. 1311 ex. Pl. Guat. Tuerckh., qu. edid. John Donnell Smith).

The new genus is probably most nearly related to Eulophus, from which it differs not only in its root and leaf characters, but chiefly in its fruit and carpels being strongly laterally flattened, its seed-face having a deep and narrow sul-

cus, and in the entire absence of a stylopodium. In Eulophus the carpels are decidedly dorsally flattened, the seed-face has a broad and shallow concavity, and there is a conical stylopodium. Donnellsmithia differs from Museniopsis in its tall and slender caulescent habit, foliage characters, the absence of a stylopodium, and its more flattened carpels. In fact, the low depressed acaulescent habit of Museniopsis, and its foliage are strikingly different from the new genus.

EXPLANATION OF PLATE II.—Fig. 1, the whole plant; fig. 2, a single umbellet; fig. 3, a single fruit; fig. 4, cross-section of the fruit, in which, however, the pericarp is too thick.

Crawfordsville, Indiana.

Leo Lesquereux.[1]

Four names will ever stand first in the list of American bryologists, those of Sullivant, Lesquereux, James and Austin. The last of the four passed away on the 25th of October last. Sullivant in 1873, Austin in 1880, James in 1882, Lesquereux in 1889—so the sad list of our losses runs. Not only as the pioneers in bryology will the names be associated; the four were, and will be in memory, linked together in common study. From 1848 till Sullivant's death, Lesquereux and he, living in the same town, were most intimately associated in the study of mosses. Sullivant assisted Austin in the determination and issuing of the Musci Appalachiani. Finally Lesquereux called to his aid James in the preparation of the Manual of the Mosses of North America.

Of the four Lesquereux reached the most advanced age. He was born at Fleurier, Neuchâtel, Switzerland, November 18, 1805, just five years, therefore, before our own Gray. His parents were of Huguenot lineage and educated their son for the church. This plan, however, was interfered with by lack of means, and at nineteen the young man was forced to earn his own money by teaching French. At twenty-four he became principal of the college La Chaux-de-Fonds in the canton of Neuchâtel, but two years later lost his hearing to such an extent that he was obliged to give up this place. To sup-

[1] It is not fitting that the labors of so eminent a botanist should go unnoticed in the GAZETTE. Efforts have been made to have this sketch written by hands better fitted to the task, but their preoccupation has devolved it upon one of the editors (B.), who perforce dwells chiefly on his bryological work.

port himself he took up the trade of an engraver of watch cases and maker of watch springs. He must have devoted all of his spare time to researches among the mosses and particularly the peat swamps, for in 1844 he presented to the local society a memoir entitled, "Quelques recherches sur les marais tourbeux en général"—a work of 140 quarto pages—and a year later a "Catalogue des mousses de la Suisse" of 54 quarto pages. In 1845 he was commissioned by the Prussian government to study the peat formation in northern Europe.

In 1848 he came to the United States and settled at once in Columbus, Ohio, where he resided until his death. His study of the formation of peat naturally led him to take an interest in the plants which grew in the geologic peat bogs, and it is easy to trace the lines of divergence of his two chosen subjects. Of his studies among the fossil plants we have not knowledge to speak, further than to say that in this field he was an acknowleged authority, and it was the one which he most loved and was able longest to pursue.[2]

Lesquereux soon became acquainted with Sullivant at Columbus, and was employed by him to make a collecting tour through parts of the Southern states. The mosses which were thus accumulated, together with many others, were issued in 1856 under the title "Musci Boreali-Americani," and numbered 416 species and varieties. Of this, as well as of the second edition, which appeared in 1865 and numbered nearly 500 species, there were only 50 copies. In 1859, in conjunction with Sullivant, he published in the Proceedings of the American Academy (iv. 275–282) "Characters of some new Musci collected by Charles Wright in the North Pacific Exploring Expedition under the command of Commodore John Rodgers." The work itself, and the plates which were prepared for the government, have never been published.

Mr. Henry N. Bolander, a resident of Columbus, removed to San Francisco early in the 60's, and sent in a wealth of new material from California. Based on this, Lesquereux published, in 1863, in the Trans. Amer. Phil. Soc. (xiii. 1–24) a paper "On California Mosses," in which many new species were described. Five years later he prepared the "Catalogue of Pacific Coast Mosses," which appeared as the first of the Memoirs of the California Academy of Sciences.

[2] Professor Lester F. Ward read a paper before the Geological Society at New York in the holidays, which will deal with this portion of Lesquereux's work. The paper is to be published in the *American Geologist*, and from it we shall hope to be able to present some extracts later.

In 1872 his sight partially failed him through excessive use of the microscope in the examination of Orthotricha. The next year his friend Sullivant died. At this time the two were preparing for the publication of a manual of mosses of North America. The loss of sight and the loss of the principal in the movement well-nigh stopped the production of the book, and probably would have done so had not interested friends urged its completion. Lesquereux therefore called in the aid of Mr. Thomas P. James, and under his hand was continued most of the microscopic work. While this was doing Lesquereux prepared the larger part of the letter-press of the Supplement to the Icones Muscorum of Sullivant from the notes left by the latter in his herbarium; but firmly declined to have his name appear on the title page of the work. In 1879, with James, he published in the Proc. Amer. Acad. (xiv. 133–141) descriptions of a number of new species of mosses. In 1882 James suddenly died, and again the long-expected manual seemed blocked. On account of failing health Lesquereux was unable to press the work to completion and a large share of the editorial work was done by Dr. Sereno Watson. The work appeared in 1884.

From this time Lesquereux wholly gave up his bryological studies. His bryological books, herbarium and manuscript notes on all the mosses he had examined were presented to the Museum at Neuchâtel, a gain to that institution not at all commensurate with the loss to this country.

Lesquereux was quite conscious of his failing powers, and it was often put to his friends in a very pathetic way in his letters. In 1886 he wrote in response to some expression about his welfare: "Allow me to thank you for your interest in my health. I have an incurable sickness—old age. I can still work on fossil botany, but can not do much." About two years ago he suffered a stroke of paralysis, which gradually increased in extent until death came to his release.

The following items regarding his family are from the Columbus *Daily Press*, to which we are also indebted for some of the facts above:

"He was married in 1830, and his wife was a highly born lady of Eisenbach, Saxe-Weimar, Baroness Sophia von Walffskeel, daughter of General von Walffskeel. In religion Lesquereux was a Reformed Protestant, or Lutheran. The whole world has been benefited by his labors. Although residing in this city for many years, he was known to com-

paratively few, and his ability can hardly be said to have been appreciated here. All who knew him held him in high esteem, as he was uniformly kind, courteous and charitable. He leaves three sons and one daughter, two of the sons, F. A. and Leo Lesquereux, living in this city, and H. C. Lesquereux in Springfield, Mass. His daughter is Mrs. Anna Earhart, widow of Edmunds Earhart, of Marion township."

Lesquereux's retiring disposition prevents us from knowing the full extent of his labors, and, perhaps, the full extent of his worth. It is safe to rank him, however, as the second bryologist of this country. The country of his adoption shares his fame with the country of his birth. His name is worthy of a place with those of his warm friends, Agassiz and Guyot.

BRIEFER ARTICLES.

Double flowers of the Epigaea repens.—This species attracted the attention of botanists several years ago by its polymorphous stamens and pistils, and its tendency to dioeciousness. It occasionally indulges in the freak of putting forth double flowers. One locality where these are produced year after year is at Plymouth, N. H. The flowers sent for examination from this place were large, deep pink in color, and with their numerous petals, much prettier than the ordinary single ones. There was great variation in the degree of transformation of stamens to petals. Three-fourths of the number of flowers examined had two circles of five petals each, the inner alternate with the outer, and five stamens alternate with the inner petals. The outer circle formed the normal salver-shaped corolla with ovate lobes, but the inner was composed of five distinct and very unequal petals with the margins irregularly indented or toothed. The filaments of the stamens were broadened towards the top, as if on the point of expanding into a blade, and bore imperfectly developed brownish anthers which rarely contained any pollen. In other flowers considerable variation in the degrees of cohesion and adhesion was observed. It was not infrequent to find two short-formed stamens adherent to the base of an inner petal.

In a few, more double flowers, the transformation of the ten stamens to petals was nearly complete, forming three circles which showed all stages of transition from a narrowly spatulate form suggestive of a broadened filament without the anther, to a perfectly formed petal. A noticeable feature in these cases was the cohesion of two or more, rarely of three, petals of the inner circles, pointing to the formation of an inner corolla tube.

The most curious change of all had taken place in the pistil, which

instead of having the ovoid conical ovary, slender style and five stellate stigmas of the typical flower, consisted of leaf-like bodies closely rolled or twisted together and an ovary broadened and flattened like an oblate spheroid. This conformation of the pistil occurred even in the least double flowers, and seemed, therefore, to be the first organ to undergo modification. A view of the pistil laid open furnished a fine illustration of the reversion of essential organs to leaves. It was composed of five, and frequently of six or seven leafy carpels, only slightly coherent at base, of a pale green color and thin in texture. The long acuminate apex of each was infolded and sometimes inclosed by the wavy-curled, involute margins of the basal portion. When the number of carpels was more than five, the extra ones were either inclosed within the others or appeared as lateral outgrowths from near the base.

Ovules were entirely wanting in the flowers with three circles of petals; in others a few were found larger and flatter than those of the single flower, and passing through intermediate pointed forms to a rounded body bearing a miniature leaf at the top.

The Epigæa receives so unkindly any attempt to cultivate it, that it would be interesting to know what peculiar conditions of its native surroundings have induced it to produce these double flowers.—KATE EASTMAN WILSON, *Wellesley College.*

EDITORIAL.

The GAZETTE greets its friends this new year and decade with fresh hopes and promises. The last decade has seen much activity among American botanists, and the GAZETTE has done its share in recording it. Much more botanical work is being done in this country now than ever before. Nearly all who hold botanical positions have seen the necessity of original work. No complaint can be made of the amount being done, but there may be a question as to the quality. We believe that the general quality of American work is improving, not merely on account of the increasing contact with foreign laboratories, but chiefly on account of better general training. Doubtless there are still instances of young men who spend a year or two in German laboratories, imbibe their egotism along with their methods, and then return with the purpose of enlightening us, but these cases are becoming fewer and must presently disappear. But if the quality of American work is improving there is still much to be desired. There are some workers of whom we are justly proud, but there are still many of the kind that have given us an uncomfortable reputation. Three kinds of work occur to us as especially abundant. The first is undertaken by those who have no conception of the meaning of original work. These are apt to write most voluminously, collating from

endless literature, but not contributing a single fact. Their measure of the value of a paper seems to be the number of foot-note references to literature. A second kind of work is really work, but is misdirected. The amount of misspent energy in scientific work is simply appalling. Some trivial subject is taken which amounts to nothing when completed, illustrating the saying, "what's true is not new, and what's new is good for nothing." A third class lay hold of subjects which are important enough, but are in such a tremendous hurry that one can not easily dissociate what they have seen from what they have guessed at. An itch for publishing is the spur which causes the natural American haste to break into a gallop. To present raw and undigested material to the botanical public is to have it all rejected.

Our attention has lately been called to these various kinds of botanical work, and we have taken this opportunity to speak of them. There is one defect, however, which is apt to be found even in good work. It is a defect which usually marks a beginner, and that is *generalization*. Papers with a small fact or two and world-wide generalizations are too common. It is well to remember that generalization is always unsafe, should never be ventured upon by a beginner, and is too often an indication of lack of facts. Generalization is only easy to one unembarrassed by facts. Happy is the veteran botanist who has no such youthful attempt to look back upon. If we could make all American botanists understand that it is their mission to collect facts with the most painstaking care, and to record them in the simplest possible way, the new decade would bring lasting honor to American botany.

CURRENT LITERATURE.

Bibliotheca Botanica.

We are gratified that this excellent series of monographs continues to be issued, for at the outset we apprehended their early discontinuance. While the series is an expensive one for the purchaser, we can hardly see how it can fail to be a more expensive one to the publisher. The elaborate style of the letter press and the exquisite plates are not equaled so far as we know, and we hope for a long continuance of the serial and wish for it an increasing constituency that it deserves. The fifteenth and sixteenth[1] parts are before us. In the former Dr. C. R. G. Schumann gives an account of the anatomical structure of the bud-scales of Coniferæ and woody dicotyledons. The usual review of the literature of the subject precedes the paper. Dr. Schumann discusses the epidermis of both outer

[1] Heft 15.—Anatomische Studien über die Knospenschuppen von Coniferen und dicotylen Holzgewächsen. 4to. p. 37. pl. 5.
Heft 16.—Beiträge zur Morphologie und Anatomie der Dioscoreaceen. 4to. p. 35. pl. 5, Cassel: Theodore Fischer. 1889. Each M. 10.

and inner sides, its cuticle, thickening, wax excretion and hair structures; the parenchymatous, collenchymatous and sclerotic elements of the fundamental system; the formation and character of the periderm; the intercellular spaces and secretion reservoirs, and the vascular bundles. The memoir is illustrated with forty-six figures on five plates. One hundred and thirty-five species of plants are listed by the author as having been examined.

In the latter Emil Bucherer offers contributions to the morphology and anatomy of the Dioscoreaceæ. His researches refer specially to Dioscorea Batatas, D. sinuata and Tamus communis, and can not readily be summarized.

Boleti of the United States.[2]

Nothing stimulates the study of a group of plants more than a good synopsis of the species. This is especially desirable when the group is absolutely unapproachable, except by the trained specialist. The mycologists are rapidly arousing interest in their department by the preparation of just such monographs as the one before us. Boleti in the herbarium are decidedly difficult, for they are so fleshy and perishable that the natural form and coloration have, to a large extent, disappeared. Professor Peck deserves the thanks of mycologists for thus seeking to facilitate the study of a group difficult, not only in the imperfection of its preservation, but also in the widely scattered publication of our American species. The *Hymenomycetes Europæi* contains 100 species, while this paper presents 110, 36 of which occur also in Europe. This large number of endemic species indicates that the United States is rich and peculiar in its Boleti. The three genera are Boletinus, Boletus and Strobilomyces, containing 5, 103 and 2 species respectively: The large genus Boletus is divided into 15 tribes, and of the 103 species 6 are new, 33 bear the name of Peck as author and 21 that of Frost.

Minor Notices.

Mr. T. S. Brandegee has published a pamphlet of 116 pages, with 12 plates and a map, containing a list of plants collected by him in Lower California during 1889. It is a reprint from the Proc. Calif. Acad. Sci. Ser. 2, Vol. ii, pp. 117-232. From the wealth of new material this paper presents, it is safe to infer that southern Lower California is a new country botanically. Many of the plants listed have not yet been determined as to their species, but in this first study of the collection Mr. Brandegee describes over 80 new species, and a new genus of Compositæ, Alvordia by name. Dr. George Vasey has determined the grasses, among which are three new species. To Dr. C. F. Millspaugh was given the Euphorbiaceæ, among which he finds 14 new species, half of which belong to the

[2] Peck Charles H.—Boleti of the United States. Bulletin of the N. Y. State Museum, No. 8, September, 1889, pp. 73-166.

genus Euphorbia. Dr. H. W. Harkness gives a list of the fungi collected, among which is a new Puccinia. Over 100 new species already described from a single season's collecting, with many species remaining undetermined, surely speaks well for the botanical riches of Lower California.

In the last numbers (37 and 38) of Engler & Prantl's *Die natürlichen Pflanzenfamilien* several orders are presented by Dr. O. Drude, chiefly the Ericaceæ. We note the following changes in North American forms as given in Gray's Synoptical Flora. Clethra is made the type of a separate order, Clethraceæ. Pyrolaceæ are again kept apart in a distinct order, which includes the tribe Pyroleæ and the suborder Monotropeæ of the Synoptical Flora, Moneses being included in Pyrola. In the order Ericaceæ, Phyllodoce of Salisbury is again separated generically from Bryanthus; Lyonia Nutt. is restored as a genus and made to include Cassandra and the section Eubotrys of Leucothoe; Arctous, one of Gray's sections of Arctostaphylos, is made a genus, and contains our Arctostaphylos alpina.

Dr. Oliver R. Willis has just revised Wood's "Lessons in Botany." In these days of laboratories and microscopes, even in high schools, there is a demand for elementary instruction in plant tissues, as well as for elementary physiology. The older text-books, in order to keep in the market, must meet this demand, and the present edition of the well-known text-book mentioned above has this in view. We are glad to see that the editor emphasizes the necessity of laboratory work, and presents the text-book merely as a full and illustrated catalogue of things that can be seen in the study of the plants themselves. The advantage of such change in our text-books is not only that it meets a demand, but helps to create one.

The eighth part of the Muscologia Gallica[1] has come from the author and publisher. It includes the genera Webera with 15 species, Bryum with 39, and 9 species of Mnium. The plates, however, do not quite complete the genus Bryum. The author is entirely conservative in regard to nomenclature, and follows Schimper almost without change in the entire work thus far. This is convenient, but hardly defensible. In the two difficult genera which are treated in this part Mr. Husnot has reduced a number of species to the rank of varieties.

OPEN LETTERS.

Once more about the weeds.

While not unmindful of the substantial aid that the botanists of the country have rendered me in the study of our weed pests, the writer, in view of the task imposed by the Biological section of the A. A. A. S. at its Toronto meeting, namely, the preparation of a paper upon "The Mi-

[1] Husnot, T.—Muscologia Gallica, descriptions et figures des mousses de France et des contrées voisines. 8°, pp. 225–256, pl. LXI–LXVIII. Cahan (par Athis, Orne); the author, 1889. 5 fr.

gration of our Weeds," begs another favor of the readers of the GAZETTE. It is to kindly report to the undersigned the advent (or disappearance) of any weed in their section of the country within the past five, ten or more years, and if possible the method by means of which the species became introduced (or eliminated). In the preparation of such a paper it is not enough to go to the books. The personal observations of the many active botanists of to-day are necessary in order to bring the treatment down to date. With such assistance there will be no excuse if the compiler fails to present matter of permanent value to both the growing of crops and botanical science.—BYRON D. HALSTED, *New Brunswick, N. J.*

Nostoc pruniforme.

I notice in the November GAZETTE (p. 291) that Professor C. B. Atwell makes a singular remark on Nostoc pruniforme with reference to my Fresh Water Algæ, saying that when my volume appeared this nostoc was not mentioned. The fact is, more is said of this species than of any other. Prof. Atwell ought to re-read page 284 and the lower half of page 279. FRANCIS WOLLE.

Bethlehem, Penn.

Ribes aureum.

In the BOTANICAL GAZETTE for November is a note by Mr. F. W. Anderson on the fruit of this species.

Here, in Eastern Oregon, the two forms with the yellow and black fruits are found. The former is very abundant, the latter more rare. "Yellowish, turning blackish," certainly does not apply to our forms any more than it does to those mentioned by Mr. Anderson as found in Montana.

In all the books, so far as I have seen, the leaves are said to be "convolute in the bud." I have examined many of the yellow-fruited form and find them invariably involute in the bud. The black-fruited form I have never had opportunity to examine in this respect.

Union, Oregon. WM. C. CUSICK.

NOTES AND NEWS.

THE RARE *Croton Alabamensis*, E. A. Smith, is described and illustrated in *Garden and Forest* (Dec. 11).

GERALD MCCARTHY, of the North Carolina Experiment Station, is preparing a historical paper on Carolina botany, and desires to purchase or borrow authentic portraits of the elder Michaux, Pursh, Elliot aud Walter.

ACTA HORTI PETROPOLITANI, vol. x. part 2 (1889) contains several articles dealing with the Siberian flora, and hence of interest to North American botanists. A list of plants collected by Slowzow in the Kirghis dèsert, and another one of the plants of N. E. Siberia, represent some of the last work of the late E. R. von Trautvetter. C. Winkler describes 20 new Compositæ from Turkestan, all of the genus Cousinia. F. ab Herder writes of the apetalous plants of the Raddean collection of Eastern Siberia, the present part containing the Chenopodiaceæ and Amarantaceæ. E. Regel gives a biographical sketch of Trautvetter, with portrait, and C. T. Maximowicz one of N. M. Przewalski, also with portrait.

IN THE December *Gazette*, p. 318, reference was made to the fact that Amos Eaton had sent three specimens of roses from the same bush to Sir Joseph Smith, who determined them to be as many distinct species. The specimens were sent by Dr. Bigelow and the story narrated by Amos Eaton (see Watson, Proc. Am. Acad. 20. 328).

THE FIRST FASCICLE of economic fungi, issued by A. B. Seymour and F. S. Earle, is now ready. The series is intended to supply a set of authentic specimens to illustrate the diseases of useful and noxious plants. The first fascicle contains 50 species, and is a general collection of destructive parasites, especially those of the vine and rose families. The price is $3.00 for specimens in envelopes, or $3.50 for a copy mounted in book form.

THE LAST annual report of the state botanist of New York, dated December 10, 1888, has just appeared. Besides the usual lists of additions to the herbarium, it contains descriptions of 44 new species of fungi, with a synopsis of the New York species of *Clitopilus* (14 species), and two plates. Our species of *Clitopilus* seem to be peculiarly American, but 2 of the 14 occurring in Europe, and 10 of them having been described by Mr. Peck.

IN THE *Journal of Botany* (Dec.) is the second report of the committee appointed by the British Association to report upon the disappearance of British plants. The alpine plants are especially the sufferers, and many of them are entirely extirpated from their well-known haunts. The blame is laid chiefly upon dealers and collectors, the summer visitors being only indirectly responsible. A list of 55 species is given, which are either extirpated or nearly so.

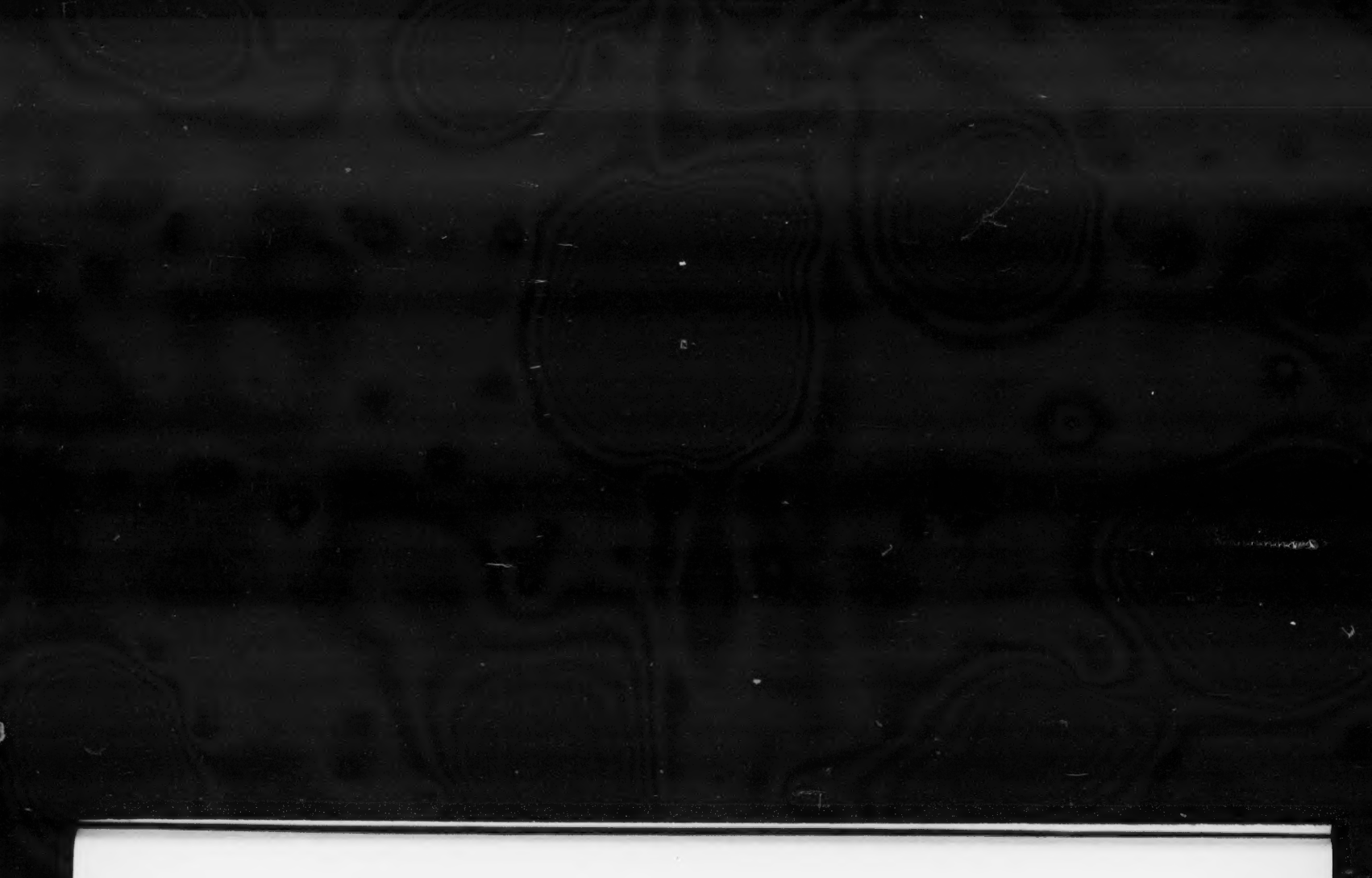
IN THE *Bulletin of the Torrey Botanical Club* for December Prof. Jos. Schrenk has a paper on "The floating tissue of Nesæa verticillata," in which is described, with the aid of three handsome lithograph plates, the same tissue which Schenk in his recent monograph (see this journal xiv. 317) calls aërenchyma. Professor Schrenk inclines to the opinion of earlier students of this tissue that it is not so much an adaptation for aeration as for floating the shoots.

IN A PAPER recently (Nov.) read before the American Academy by Dr. Geo. L. Goodale, the author gave some results of a series of experiments on the effects produced on some tropical plants by a temperature of 40 to 34 degrees. Briefly stated they are as follows: (1) no physical injury apparent to the cell-wall; (2) effect on protoplasmic contents merely a reduction of rate of circulation; (3) no appreciable change in the size of sap-cavities; (4) a notable reduction of the power of plasmolytic agents, plainly pointing to a diminution in the power of absorption.

AS THERE continues to be a call for the key to the genera of mosses published in 1886 by one of the editors (B.), the announcement is made that the edition is now entirely exhausted. There is reason to think that this key has been helpful to a considerable number of the less experienced students of mosses and has perhaps encouraged some to undertake their study. The author has, therefore, with the hope of still further increasing the number of amateurs, undertaken the preparation of keys to the species of the larger genera of mosses, and hopes to republish the key to genera with this additional matter at an early day. He would be thankful, therefore, to have any errors or omissions in the key to genera pointed out.

AN INTERESTING list of Alaskan plants is published in Proc. Nat. Museum, vol. xii, pp. 217 and 218, among the scientific results of explorations by the U. S. F. Com. steamer Albatross, in 1888. The plants are named by Dr. George Vasey, and give information concerning a region that is always interesting and too little known. Fifty-nine species are enumerated, 7 of them being Compositæ, 5 Cyperaceæ (4 of which are species of Eriophorum), 4 each of Rosaceæ and Scrophulariaceæ, 3 each of Ranunculaceæ, Saxifragaceæ, Ericaceæ, Gramineæ and Filices, the rest scattered through various orders.

THE INDIANA ACADEMY OF SCIENCE met in Indianapolis December 30 and 31. Of the 72 titles presented nearly 20 were botanical. The subjects were as follows: Some remarkable floral variations, *C. W. Hargitt;* Some anatomical structures of Epiphegus, *E. M. Fisher;* Stem characters in Compositæ, *Harry Seaton;* Some Indiana mildews, *M. A Brannon;* Plant reproduction, *W. J. Spillman;* Plants new to Putnam county, *C. T. McDougal;* Plants new to Vigo county, and Some new Compositæ, *W. S. Blatchley;* Determination of lower plants, and The trees of Indiana, *Stanley Coulter;* Development of the macrospore of Isoëtes, and Method of sectioning delicate structures, *Douglas H. Campbell;* Variation of plants immature seeds, *J. C. Arthur;* The "snake cactus," Stone characters in Nyssa, Distribution of Cornus, Epiphegus and Mycorhiza, and The National Herbarium, *John M. Coulter.*

AGATHIS AUSTRALIS (the Kauri) is the monarch of the New Zealand forests, and although it does not rival the giant Sequoias of North America in its extreme height and circumference, it excels them in the intrinsic value of its timber, which possesses a larger number of good qualities than any other pine known to commerce. The interior of a large Kauri forest affords one of the most impressive scenes in the colony. Smooth gray trunks rise on all sides, like massive columns, perfectly straight and symmetrical to a height of 80 feet or even 150 feet, with a diameter of from 4 to 15 feet or upwards. In addition to its exceedingly valuable timber, this tree furnishes abundance of resin known as Kauri gum, large quantities of which are also dug up at a depth of 6 to 7 feet from the ground once covered by primeval forests of this tree.—*Gardiner's Chronicle.* The Kauri pine is illustrated in *Garden and Forest* of December 4.

THE TRUSTEES of the Missouri Botanical Garden, in pursuance of the policy outlined in this journal, xiv, 288, announce the establishment of six scholarships for "garden pupils," which are to be awarded before the first of April by the Director upon competitive examination. These scholarships are open to young men between 14 and 20 years of age, of good character and possessed of at least a good elementary English education. They may be held for not more than six years if suitable ability and fidelity are manifested. Such pupils are to be regarded as apprentices of the garden, and are to be required to work in it under the direction of the head gardener during the first year for 9 to 10 hours daily; in the succeeding years not more than 5 hours daily, the remainder of their time being taken up with instruction and reading in a graded course including practical and theoretical topics pertaining specially to a gardener's work. In addition to comfortable lodgings, convenient to the garden, each pupil will receive wages amounting to $200 for the first year, $250 for the second and $300 for the succeeding years. Applications for these scholarships must be in the hands of the Director (Dr. William Trelease) not later than March 1. The examination will be held at St. Louis on Tuesday, March 4, and the successful candidates will be initiated in their work on the 1st of April. Further information may be obtained by addressing the director.